EX/ES/EM/T103A/T/2024(S)

B.E. PRINTING ENGINEERING

(1ST Year, 1st Semester)

SUPPLEMENTARY EXAM 2024

ENGINEERING MECHANICS

Time: 3hrs. **Full marks: 100**

Assume acceleration due to gravity(g) as 9.81 m/sec².
(Attempt any 10 quesations)

1. A force vector is defined by the expression **F= (9i - 2j + 6k) Kgf**
   Determine the following:
   (a) The **scalar component** of the **forces;**
   (b) The **magnitude** of the **force;**
   (c) The **direction cosines** of the **force;**
   (d) The **unit vector** in the **direction of the force.**

2. Determine the moments of the tension 'T' about point P and about point O, as shown in **FIGURE-2.**

3. A loaded cantilever beam as shown in **FIGURE-3**. Find the moment of forces about O.

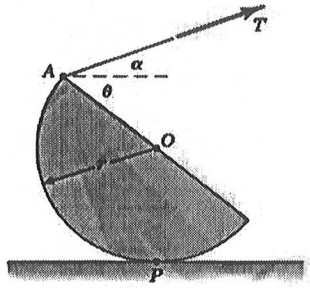

FIGURE-2

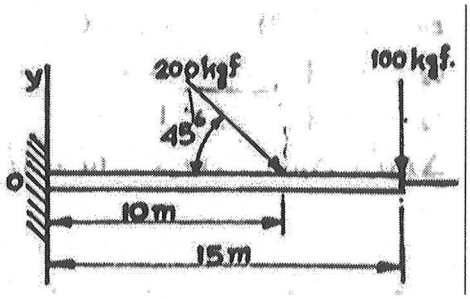

FIGURE-3

4. The three forces act perpendicular to the rectangular plate as shown in the **FIGURE-4.** Determine the moments M1 of F1, M2 of F2, and M3 of F3, all about point O.

5 State and prove the **LAMI's theorem.**

[Turn over

6. **Determine** the tensions in the cord '**AB**' and '**BC**' supporting a Block of weight **250Kgf** as shown in **FIGURE- 6**.

7. Two smooth spheres as shown in the **FIGURE - 7**, each of radius **500 mm** and weight **500 Kgf** rests in a horizontal channel having two vertical walls, the distance between the walls being **1750 mm**. Find the force exerted on the walls and the floor at the points of contacts.

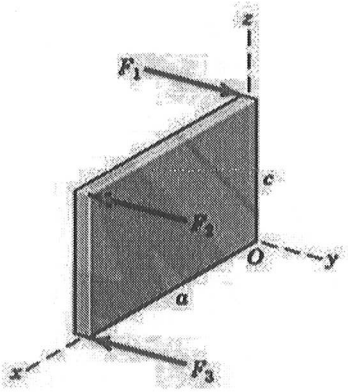

FIGURE-4

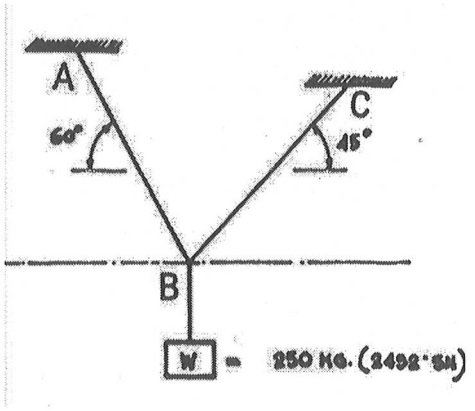

FIGURE-6

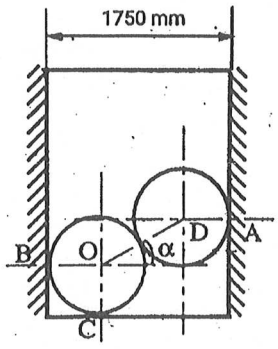

FIGURE-7

8. In **FIGURE-8,** Shown. Determine the least value of the horizontal force P to be applied to push block **A** upward if **μ** for all contact surfaces is **0.1**. What would be the value of P if there were no friction?

9. The solid semi-cylinder of mass '**m**' and radius '**r**' is rolled through an angle '**θ**' by the horizontal force '**P as shownin the FIGURE- 9**'. If the coefficient of static friction is '**μs**', Determine the angle '**θ**' at which the cylinder begins to slip on the Horizontal surface as '**P**' is gradually increased.
What value of' **μs**' would Permit '**θ**' to reach **90°**? (10)

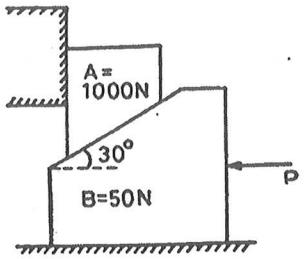

FIGURE-8

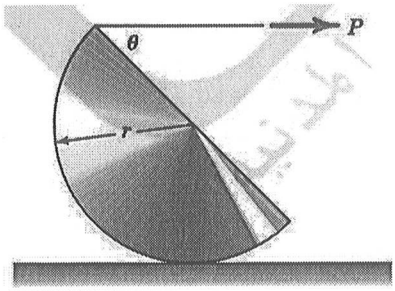

FIGURE-9

10. **State** and **prove** the **parallel and perpendicular axis theorem** of **area Moment of inertia of lamina.**

11. State and prove **papus and Guidinus** theorem . What are the application of **pappus and Guidinus Theorem**.

12. Determine the area M.I. of the rectangular lamina about the centroidal X0 and y0-axis , the centroidal polar axis z0 through C , the x-axis, and the polar axis z through O. Shown in **FIGURE-12**.

13. **Determine** the **coordinates** of the **centroid** of the **shaded area as shown in the FIGURE-13**.

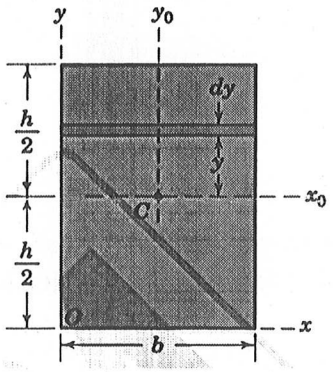

FIGURE-12

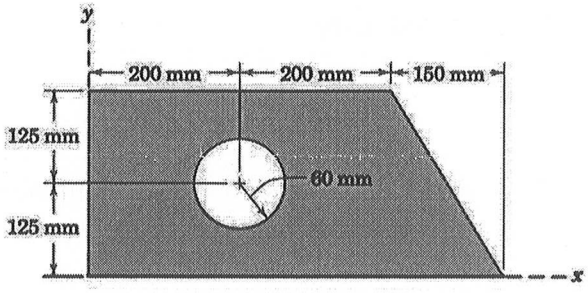

FIGURE-13

14 Obtain an equation for the **trajectory** of a **projectile** (in vacuum) from The equation of motion and show that it is a parabola and also from it Find the **range, maximum height** and **total time of flight**.

15. **The pilot of an airplane pulls into a steep 45° climb at 300 kM/h and releases a package at position A as shown in the FIGURE-15. Calculate the horizontal distance s and the time t from the point of release to the point at which the package strikes the ground.**

16. **Cylinder B has a downward velocity in m/sec as shown in the FIGURE- 16. and given by the equation VB = $t^2/2 + t^3/6$,Where t is in seconds. Calculate the acceleration of A when t = 2seconds.**

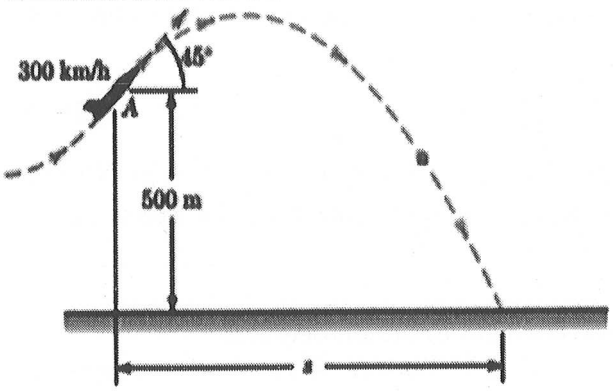

FIGURE-15.

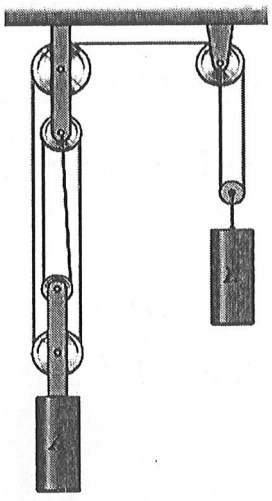

FIGURE-16.